Age Effects on Cortical Thickness in Cognitively Normal Elderly Individuals

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Background:
According to the Department of Health and Human Services, the aging population in the United States will grow to an estimated 72.1 million by 2030, more than twice the number of older adults in 2000. Currently, there are many studies being conducted to investigate structural, cognitive and functional changes in normal aging. Normal aging results in both grey and white matter atrophy. The prefrontal cortex and the frontal lobe white matter are thought to be the most affected regions.

Objective:
To examine the effects of normal aging on cortical grey matter using a 3D quantitative cortical mapping method.

Methods:
44 cognitively normal elderly (NC) participants in the UCLA Alzheimer’s Disease Research Center longitudinal database were scanned with an SPGR T1-weighted magnetic resonance imaging sequence with the following parameters: TR 28 ms, TE 6 ms, FOV 220 mm, 256x192, slice thickness 1.5 mm. All participants received a 4-hour-long detailed neuropsychological battery and scored in the age- and education-adjusted cognitively-normal range on all measures. Imaging data were spatially and intensity-normalized. Following 3D hemispheric reconstruction, 38 sulci per hemisphere were traced. Individual cortical surfaces were parameterized, flattened and warped to explicitly match data from corresponding gyri across the dataset.

Segmented gray matter maps were used to calculate cortical thickness at each surface point. Linear regression analysis was used to study the effect of age on cortical thickness. We controlled for multiple comparisons with a permutation analysis, using a threshold of p<0.01.

Results:
We found significant negative associations between age and cortical thickness in the right hemisphere (p_corrected=0.009), and trend level associations in the left hemisphere (p_corrected=0.081). The cortical areas showing regionally significant association with age were the bilateral sensorimotor [Brodmann area (BA) 1-4], supplementary motor (medial BA 4 and 6), dorsal anterior cingulate (BA 24), posterior inferior temporal (BA 37) and visual association cortices (BA 18-19), as well as the right premotor (lateral BA 4 and 6) and posterior parts of the prefrontal cortex (BA 8, 9 and 44), the left precuneus/posterior cingulate (BA 23 and 31) and the primary visual cortex (BA 17).

Conclusions:
Our findings suggest that different regions of the cortex show different susceptibility to aging. The observed pattern seems to be distinct from the one seen in AD. Aging shows an effect on the primary sensorimotor and visual cortices and seems to spare the entorhinal/parahippocampal areas. Future longitudinal analyses of the effects of aging on brain structure will be needed to further improve our understanding of the differential effects of normal brain aging and neurodegeneration due to AD.


Table 1. Demographic characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>NC N=44</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>66.1 (7.2)</td>
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<tr>
<td>Gender (M:F)</td>
<td>26:18</td>
</tr>
<tr>
<td>Education (years)</td>
<td>17.3 (2.4)</td>
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<tr>
<td>MMSE</td>
<td>29.3 (0.8)</td>
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